DOCUMENT RESUME

ED 105 335 CG 009 705

AUTHOR	Judy, Chester J.
TITLE	A New Look at the High School Record as a Source of Information for Predicting College Achievement. Final Report.
SPONS AGENCY	National Inst. of Education (DHEW), Washington, D.C.
BUREAU NO	BR-3-1771
PUB DATE	75
GRANT	NEG-00-3-0093
NOTE	46p.
EDRS PRICE	MF-$0.76 HC-$1.95 PLUS POSTAGE
DESCRIPTORS	*Academic Achievement; *Admission Criteria; *College Admission; Data Collection; *Grades (Scholastic); Predictor Variables; Records (Forms); Research Projects; Secondary Schools; Testing

ABSTRACT

It has generally been shown that the high school record is the best single predictor of college-level achievement, and that the most valid predictors accrue when high school record information is given more weight than selection-test scores in admissions decisions. In actual admissions practice, however, test scores are often given the most effective weight. In the first part of this report, four main points are made in connection with past studies on college admissions. Results from a study carried out in Texas by the authors is reported in which the focus of attention was on standards and policies that govern admission to post-secondary education. It was found that exclusive use of either a high school grade-point-average or a high school rank did not provide optimum prediction of college grades. The authors concluded that in making college admissions decisions and recommendations, it is generally best to use a carefully obtained high school rank in conjunction with an empirically developed high school transcript score in the prediction of college achievement. In the presence of these two indexes, used jointly, selection test scores become redundant. (Author/PC)

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FINAL REPORT

A New Look at the High School Record as a Source of Information for Predicting College Achievement

National Institute of Education Project No. 3-1771
NE-G-00-3-0093

Project Director: Chester J. Judy

San Antonio, Texas

1975

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Foreword

Although academic aptitude and "intelligence" remain as interesting theoretical concepts subject to further refinement, it is now beginning to appear that these constructs are not necessary ones, at least with respect to college admissions. Even for the purposes of classifying exceptional children, the necessary use of educational and psychological tests is being increasingly questioned. Based on the findings discussed in the widely-noticed Hobbs Report, Nicholas Hobbs recommends that tests should not be used at all, generally, except for research purposes. He warns that "categories and labels are powerful instruments for social regulation and control, and they are often employed for obscure, covert or hurtful purposes: to degrade people, to deny them access to opportunity, to exclude 'undesirables' whose presence in some way offends . . ." (The Futures of Children, Jossey-Bass, in press). To the maximum extent feasible, "mainstreaming" is recommended.

Testing for college admissions, and for college counseling and guidance, is an especially costly enterprise. At almost any large, urban high school, students and their parents spend, each year, as much as $15,000.00 to pay the "non-profit" testing agencies for the opportunity to take one (or sometimes both) of the commonly-used college entrance examinations. In a moderately-sized metropolitan area (such as in San Antonio, Texas) the yearly sum can be more than $150,000.00. In an area as large as Texas, the total amount can be as much as $1,500,000.00 each year.

Some parts of the above amounts, again each year, go to high school and college counselors who are, in some unspecified manner, selected to give the examinations. Larger parts of the above amounts go to help finance the research and publication efforts of test-oriented professionals. Strategically-located persons in higher education, including many with no particular expertise in tests or testing, are asked to serve on advisory boards of the testing organizations,

and are invited to attend interesting parleys that are not inexpensive, logistically. At one of these (in May, 1974) to mark the dedication of a new conference center at Princeton, New Jersey, the President of the Educational Testing Service jokingly recited this little verse in his opening remarks:

> There was a young lady of Kent,
> Who said that she knew what it meant
> When men asked her to dine,
> Gave her cocktails and wine.
> She knew what it meant, but she went.

Many of the procedures now used in the selection of students for higher education were devised and adopted when computers were in a rather neolithic stage of development. This report ends with a modest proposal that new attention be given to the secondary-school record as an economical and more comprehensive source of information for predicting college achievement, and that advantage be taken of computer technology in exploiting this information. The recommendations include one offered as a partial solution to the "hierarchy" problem among educational institutions at the college and university level.

It was in San Antonio, Texas, that a three-judge panel ruled in favor of Rodriguez (reversed 5-4 by the Supreme Court). Not all the Rodriguez children in the San Antonio metropolitan area reside in the Edgewood District, nor are they all Brown. Serious thought is now being given, state-wide, to the matter of equitable financing of schools. It seems quite likely, however, that the terms local control, local enrichment, and individual needs will often be serving as code words for a continued non-agreement with what the courts have been trying to say. A few school board members, especially those in the more affluent suburban areas, are now displaying an uncommon interest in test results, and in any other information that can be used as a reasonable and publicly-justifiable pretext for treating children differently.

Acknowledgments

This project, independently planned and conducted, could not have been completed without the helpfulness and courtesy (or forbearance) of Dr. Jerome F. Weynand, President of Colleges, San Antonio Union Junior College District; Dr. Paul R. Culwell, Dean, San Antonio College; Mr. Glenn A. Doolittle, Registrar; Mrs. Phyllis N. McCarley, Associate Registrar; Mr. A. Glen Hamilton, Director of Counseling and Guidance; Mrs. Maxine Sigman, Assistant Director; and Mrs. Mary Brogan, Office Supervisor, Counseling and Guidance. The large clerical task of assembling information for the project was carefully carried out by Mrs. Gisela Malesky, Mrs. June Cook, and Miss Frances Misc. The information was placed on IBM cards at Data Punch, Inc., San Antonio, under the supervision of Mr. Ross Estep. Analyses of the data were completed on the IBM 370, Model 155, computer at Trinity University.

Contents

	Page
Foreword	iii
Acknowledgments	v
List of Tables	vii
Introduction	1
Objectives	9
Related Research	11
ACT Program	12
Other Studies	13
The Military Experience	14
Procedures	17
Subjects	17
The Data	18
Results	19
Discussion	23
Summary and Conclusions	26
Recommendations	30
References	34

List of Tables

Page

1. Statistically Significant Items of Information from the High School Record which Predict Academic Order-of-Merit at the Air Force Academy 36

2. Variables (Listed by Code) Showing Means, Standard Deviations, and Intercorrelations 37

3. Sequence and Results of Regression Problems 38

A New Look at the High School Record as a Source of Information for Predicting College Achievement

Chester J. Judy

A socially relevant problem periodically receiving more than a minimum amount of attention is one pertaining to college admissions. There is much difference of opinion regarding the number of young men and women in the total population that should be planned for, accepted, or received, this ranging from the number of the "academically talented" only, as low as 15 per cent of the present number of secondary school graduates propounded by a few non-egalitarian writers, to as many as 100 per cent of the number of those graduated. In European countries, where much smaller percentages are in the possible range, the question is a matter of the fair sharing of existing space, an issue never satisfactorily resolved, and one to which new thought is being given (Bereday, 1973). In those countries there is an increasing level of conflict between traditions that guarantee a university place for every graduate of a "higher" secondary school and the perceived economic need for a numerus clausus (the Latin phrase for restricted admissions). Many Europeans are dismayed when they learn about the American system of pre-college testing and "interviewing." At the same time, in many places, there is some movement away from the practice of channeling students into different types of secondary institutions at about the age of eleven or twelve. A common curriculum in a "common" school (now becoming somewhat less common in American secondary education) appears to be one of the intermediate goals in several places.

In the United States the administrative trend, on the long term, has been toward the expansion of higher education facilities so that larger numbers of young people might be able to attend some college, at least for one or two semesters. Increasingly, however, the annual contest is for admission to the "better" institutions, those described by Bereday (p. 42) as "pockets of struggle

over admission" which "reproduce in miniature the tensions existing on a national scale in elitist countries." (Once accepted, a student's chances for survival in American higher education are, paradoxically, much better at the prestigious locations.) The intensifying competition is not surprising in view of the expanding awareness of the economic and social advantages that accrue to young people who attend the more selective schools. This is not to say that all the best instruction is given at elite colleges and universities, or that the curriculum and the physical plant at some of the lesser known places in the United States are always incomplete or inadequate. On the matter of the "quality" of the student body, some of the students in a typical college at the "lower" end of the American hierarchy typically have academic qualifications equivalent to the qualifications of the average applicant ceremoniously admitted to schools at the "higher" end. A more conspicuous difference between the institutions at the two ends of the hierarchy is often the magnitude of the student-faculty ratio or the student-tutor ratio. Some critics of higher education maintain that rising tuition and living costs are now serving to re-establish prestigious campuses as enclaves for young people from wealthy and influential family backgrounds. In some places, however, financial aid plans are permitting the enrollment of more students from "poor" backgrounds. The present trend is toward fewer students from middle income groups.

When a college or university, any college or university, admits some applicants and rejects others, a question often asked is: How are these decisions made? Or: How <u>should</u> such decisions be made? Many informed people in the academic community, and also in the larger body of educated laymen, believe that the fairest basis for admission is one on merit that favors applicants in accordance with the best possible estimate of their relative prospects for doing well in a particular academic setting. Admission test scores (such as those on the Scholastic Aptitude Test developed for the College Entrance Examination Board or tests produced by the American College Testing Program) have, in the last 25 years, been

accorded special status as acceptable predictors of achievement at the college level. Academic achievement in high school (usually high school grade-point-average or rank based on that average) is also widely recognized as a "good" predictor. Although the catalogs of selective colleges sometimes give the impression that careful thought is given to a broader range of qualifications, and although other information is sometimes actually used in the development of selection equations, such information generally adds only a trivial amount to the predictive utility of test data and/or the high school record. This is true even though test data and/or high school record data, in their very best present applications, can be used to account for only a moderate amount of the variation in college performance.

Hundreds of studies have shown that prediction of college achievement based upon a weighted combination of test results and information from the high school record (such as high school rank) are more accurate than predictions made from test scores alone, or from the high school record alone. These studies have also generally shown that optimum prediction is obtained when more consideration, or weight, is given to high school record information than to the test information. Hoyt (1968), for example, in a sampling of fifty colleges, found that the best-weight equations for predicting college grades ranged from weighting test scores and high school grades in the ratio of 1 to 0.7, to weighting test scores and high school grades in the ratio of 1 to 3.2, with a median ratio of 1 to 1.2. This particular study was sponsored by the American College Testing Program. The median ratio of 1 to 1.2 for weighting test scores and high school grades was used in developing "general" prediction equations (one for men and one for women) for each of 985 four-year colleges.

Several points should be made in connection with the earlier studies on college admissions, including the one conducted by Hoyt. The first and most important is that it is not at all clear that an "average" grade completely or adequately represents or summarizes the heterogeneous content of a "high school

record." An "average" grade masks important differences with respect to the courses different students take. The lack of standard approaches to the computation of averages, and the common scarcity of effective review procedures for correcting ordinary computational errors, contribute further to the unreliability of "grades." (In this report, quotation marks will generally be used with the terms high school grades and high school record to show that the intended reference is to one of the presumably less-than-optimum, but commonly-used, measures of secondary-school achievement.) The assembly, treatment, and use of test data, on the other hand, is not so undisciplined. This leads to the initial observation that a ratio on the order of 1 to 1.2 for weighting test scores and "high school grades" may be a somewhat conservative one with respect to the last value in the ratio. Any improvement in "grades" data will operate to increase their relative weight in best-weight equations of the kind developed by Hoyt and other careful investigators.

A second point in connection with the findings of past studies on college admissions is that the recommended ratios for weighting test scores and the "high school record" are empirically derived. Whatever the deficiencies in grades or grading, the recommended ratios reflect the existing utility of the educational data in best-weight prediction equations. It is often erroneously inferred that, relative to "high school grades," test scores are more dependable and valid for selection purposes because of known differences in grading practices and standards. There are differences in these practices and standards, but the differences, though quite large sometimes, are not generally large enough to justify the negative inferences commonly made.

Although almost all best-weight selection equations clearly indicate otherwise, test scores are usually given more consideration than "high school record" information when college admissions decisions are made (Wing and Wallach, 1971). The same thing occurs in certain other selection decisions (Judy, 1959). Apparently, a substantial and critical number of people in education underestimate

the predictive utility of educational records. Goslin (1967) found that the more psychometric training teachers and counselors reported having, the more likely they are to rely upon "aptitude" scores as the principal factor in counseling and placement recommendations, and the more likely they are to accept the idea that differences in aptitudes tend to be rather fixed characteristics showing the "important" or "real" differences between students. There seems to be no shortage of professional opinion that reflects considerable confidence in, and traditional reliance upon, "aptitude" or "ability" scores. This carries through all the way to the testing done for admission to graduate-level education, at which place and time the previous academic record has become a rather lengthy one.

Some writers give socio-political reasons for the emphasis on "ability" testing in education settings up through the secondary level. Mercer (1974) for example, noting that the educational system is the primary institution for allocating persons to adult social and economic status, maintains that tests serve important "latent functions" in education, one of which is to affirm and perpetuate the status of persons in subordinate, culturally different, or disadvantaged groups. Testing, Mercer observes, has the objective consequence of assigning disproportionate numbers of young people from particular groups to educational programs and tracks which have low ceilings and which provide limited access to higher education. She also has some interesting comments on the "cooling out" role of mental testing in educational settings.

Tyler (1973), in a presidential address for the American Psychological Association, relates that "reputable psychologists [now] argue that intelligence tests do not measure intelligence, and never have" (p. 1023). One of the principal gains of the last few years, unfortunately not yet fully subscribed to by many people in education, has been the greater realization of the subtlety and complexity of the forces that combine to determine relative standings on tests of intelligence or mental ability, or of "academic aptitude." The response to this

particular realization has not yet been a noticeable modification of widely-held notions on the special utility of tests for college admissions.

There has been, in the last few years however, a somewhat greater willingness to consider the use of "modified" college admissions policies for persons in some of the larger minority groups, but these policies have tended to draw attention away from the unused predictive utility of secondary records. In several places, major efforts have been made to develop special admission schedules for the matriculation of members of specified groups, all using test data as the critical information. A modified approach of this kind does seem to be justified by the spurious circumstance that aptitude tests predict about as well (or sometimes better) within important minority groups as they do within groups made up, exclusively, of other identifiable persons. The circumstance is also cited in justifying the statistical efforts that have been made by test-oriented persons and agencies to make selection recommendations, those based on testing results, more "fair" under different assumptions of what constitutes fairness. Consensus concerning the use of modified selection procedures in college admissions has not yet been reached, and this does not seem likely any time soon. In the meantime, differences in average test performance between groups continue to operate on a rather large scale to the disadvantage of many young persons. Contrariwise, it is sometimes pointed out that provisions for quotas, or statistical procedures for modifying selection equations, tend to become unmanageable or confusing when it is possible to identify more than a few special groups, and that, in being more "fair" to some applicants, an admissions officer or selection committee becomes less "fair" to others. It is also sometimes noted that when such modifications are made, there is a necessary reduction in the overall effectiveness or efficiency of the total selection operation.

A related matter, especially in some of the larger state systems of higher education, is the policy on admissions in which the relative weight of test

data and information on secondary performance has been established and publicly announced. This quasi-legal arrangement is often made when enrollment control measures, in an acknowledged hierarchy of state institutions, are thought to be desirable. The main trouble here, however, has again been the almost universal practice of adopting auxiliary rules that modify the effective weights of the selection variables. The minority-majority matter may or may not be at issue. But when minimum test scores or minimum high school grade averages (or class rank), or both, are specified in the announced admission requirements, restriction in range on those variables is introduced. When this happens it is very unlikely that end results in selection will closely resemble the selections mandated by selection formulas supposedly in effect. Bias in favor of test data, at the expense of information on secondary performance, again generally prevails. When cut-off scores are arbitrarily fixed below which no applicants are acceptable is to put tests to purposes for which they were not developed.

A third point in connection with past studies on college admissions is that even the best weights given to the best predictors do not permit forecasts of college achievement that are particularly accurate. Actually, not more than about a third of the variation in college performance can generally be predicted through the use of test scores and "high school record" information. (If, for example, the relationship between college performance and these two kinds of information can be represented by a multiple correlation (R) value of .55, properly corrected for restriction in range on the selection variables, then $R^2 = .30$. Multiplying the .30 value by 100 shows that only 30 per cent of the variation in college performance is accounted for.) It is obvious, then, that there is considerable room for improvement in the prediction of college-level achievement, and that who goes to college, and exactly what college applicants get into, is, in some large part, not explained by the available "qualifications" data. Some moderately selective colleges and universities are now setting aside special periods

(e.g., a summer quarter) when high school graduates with "low" selection test scores are given an opportunity to demonstrate the "capacity" for doing college work.

A fourth and final observation is that, historically, for the purposes of academic prediction, much more attention has been given to the measurement of "intelligence," "mental ability," and "scholastic aptitude" than to the quantification of any equivalent amount of data obtainable from the existing academic record, data extending over a longer sample of an individual's functioning than two or three hours of test behavior. In test construction, methods of item-selection and test-refinement have been carefully studied and routinely used for almost seventy years. On the other hand, almost no effort has been devoted to the identification and quantification of significant items of information on existing school records, or to the identification of items which should be given effective weight in arriving at a summary record "score." Persons in college admissions, including those with research responsibilities on the topic, seem to have given little attention to this matter. They continue to recommend, and they apparently are satisfied with, the auxiliary use of grade-point-averages and rank in high school class to guide admissions decisions. It is fair to observe, however, that investigators in other topical areas often employ even less precise "measures" of educational accomplishment, such as "educational level" or "years of education," for use in investigations in which relationships between "education" and certain post-academic performances are studied. Not surprisingly, the obtained relationships are usually not large enough to be of any practical significance.

Educational institutions tend to be ranked, and they rank themselves, on the basis of the "quality" of the students they are able to attract. Some critics argue that programs, policies, and publications of the testing agencies themselves, and individuals with vested interests of one kind or another in testing, serve to support and popularize the role of testing in defining and establishing the pres-

tige hierarchy among American colleges, and in preserving college admissions as one of the major test-anchored areas of American life. Average score on the commonly used admissions tests is widely accepted as a meaningful index of the desired "quality." Astin (1971), in one available publication, provides these data for 2300 American colleges. Accordingly, it is rare for a selective school to admit significant numbers of applicants with "low" test scores.

On the other hand, equivalent data on the high school accomplishments of students admitted to the various colleges and universities of the country have not been made available, nor have they been reported in any useable format. At best, a student's high school rank or raw grade-point-average is available among the auxiliary data, but it is not possible to relate this "record" in any systematic or precise manner to the "records" of other students who have been admitted to a particular college or university, as it otherwise is with respect to test scores. Very little has been attempted, in any context, state, or country, to develop a more satisfactory summary measure covering the secondary-school record, or to make relevant comparative data available on an existing number of post-secondary institutions.

Objectives of this Study

The scheduling of the present investigation was suggested, in part, by the opening of a new branch of the University of Texas at San Antonio, Texas. A large campus for the University of Texas at San Antonio (UTSA) is now under construction. There are four non-public colleges and universities in the city (St. Mary's University, Trinity University, Our Lady of the Lake College, and Incarnate Word College) having a total of about 11,000 students, and two public junior colleges (San Antonio College and St. Philips College). The largest of the two-year colleges, San Antonio College, has a total enrollment of almost 20,000 students, more than the number of students enrolled at all the other institutions combined. Because of construction delays at the new UTSA campus, and because of advances in

the date when undergraduate students can be accepted (now projected for the Fall of 1976), prospective UTSA students have been encouraged to begin their post-secondary programs at San Antonio College. Apparently, many have chosen to do so. The principal source of the data for the present study was the high school records of a sample of full-time, freshman students at San Antonio College.

In several ways, the situation in higher education in the San Antonio metropolitan area is a microcosm of higher education in the State of Texas, and to some extent, in the nation as a whole. There is, for example, the ongoing expansion in education facilities so that everyone, or almost everyone, who wishes can find a place in some college or university. There are different admission policies, and the same possibilities for differences of opinion over how these policies do, or should, relate to one another. To some degree there is an existing prestige hierarchy among San Antonio colleges and universities, and, with no change in stated admission policies, the hierarchy will probably become a more pervasive one. There is the concurrent problem of how to be fair to an important number of "minority" students. There is a parallel existence of privately-supported and publicly-supported institutions, and the financial and organizational problems faced by the private institutions where fees must necessarily be higher than those asked at the public colleges. There is the same necessity to coordinate programs, policies, and curriculums so that there will be a public perception of minimum duplication and waste in the total amount of resources for higher education. Instruction is, or will be, carried out at two-year, four-year, and university-level institutions. There is the same obligation to view the higher education enterprise, in its total configuration, as an important means for providing for the optimum development and education of <u>all</u> students. As elsewhere, the most important innovations in higher education are the possible ones that begin with a reassessment of what goes on at the admission gate.

This, then, is the developing milieu in which the present investigation

was planned. From the perspective of the current state of the art for college admissions, there is, here, both an opportunity and, it seems, almost an obligation to take a new look at the high school record as a source of information for predicting college achievement. Are the accepted generalizations concerning the relative utility of test scores and information from the "high school record" true in the local situation? Does the use of a high school "grade-point-average" (HSA), or rank based on that average (HSR) lead to erroneous conclusions concerning the maximum predictive utility of measures derived from the previous academic record? It is believed that answers to these questions will have important implications for educational practice both here and elsewhere.

In the process of attempting to find an answer to the last of the above questions, a high school transcript score (HSTS), a hypothetically better "measure" pertaining to the high school record, is generated and evaluated in context with other information of the kind normally employed in making recommendations and decisions on college admissions. Before proceeding with a description of the procedures used in this task, reference will be made to some earlier research which seems to be relevant to the understanding and evaluation of those procedures.

Related Research

In a review of 263 college admission studies conducted over a ten-year period, Fishman and Pasanella (1960) reported a mean correlation of .50 between "high school grades" and grades obtained in the first year of college (versus a correlation of .47 between test scores and grades obtained in the first year of college). In the course of this review a reference is made to the work of Bloom and Peters in an unpublished study in which a plan was advanced for defining, better, the relationships between high school grades and college averages. The proposed method called for statistical corrections for intraschool and interschool nonequivalence of grades, and, although some writers have subsequently questioned the practical implications of the proposal, this early citation does

highlight the circumstance that the mean correlation of .50 between "high school grades" (HSA or HSR) and college grade-point-average (CGPA), may be a somewhat conservative estimate of the possible magnitude of that relationship. The reviewers were of the opinion that the Bloom and Peters method, "and other such methods," should serve to "clarify the real predictive power of high school grades" (p. 302).

Fishman and Pasanella also provided an estimation of how much test scores might "add" to the observed relationships between "high school grades" and college performance. In a separate look at 21 studies in which aptitude test scores and "high school grades" were used in linear combination to predict CGPA, they noted a median increase of .07 in the correlation value. (Astin (1971) more recently reported that when test scores are used in combination with "high school grades" to predict CGPA, the increase is from .50 to .51 for men, and from .52 to .55 for women. The more definitive Astin study was based on a national sample of 36,581 students who entered 180 different colleges in the Fall of 1966. The increases here seem not large enough to be practically significant.) The most commonly used tests, in order of the number of times they were cited in the earlier review, were the Scholastic Aptitude Test of the College Entrance Examination Board, the American Council on Education Psychological Examination for College Freshmen, and the Ohio State University Psychological Examination.

The ACT Program

One of the most important examinations now being widely used in college selection activities in the United States was not mentioned in the Fishman and Pasanella review. These are the tests provided by the American College Testing Program. A unique aspect of the ACT Program is the recommended use, for predictive purposes, of certain data from the high school record. In particular, examinees are asked to report their last high school marks in mathematics, natural science, social studies, and English. These marks, along with test performance

information are used separately to predict college averages in the four academic areas, and also to predict an overall CGPA. In the operation of the ACT Program, examinees are asked to refresh memories, if necessary, concerning their last high school grades in the four courses before presenting themselves for testing. They are told that their marks, as given by themselves, will later be reported back to the school. It appears that these grades are furnished with a reasonable degree of accuracy.

No claim has ever been made in ACT Program research reports concerning the special utility of high school record information. Rather, it has been observed (Lindquist, 1961) that "marks made in just four selected semester units of high school are practically as good for predictive purposes as is the high school grade point average based on the entire four-year high school record of the student, or the rank in graduating class based on this overall grade point average" (p. 17). The observation leaves room for expecting the remaining elements of information on the high school record to have some residual utility for improving the prediction of college performance. Also, the four self-reported grades for the ACT Program are grades in the Junior year of high school. Generally, grades earned in the Senior year of high school are better predictors of college grades.

Other Studies

There have been other studies, more recently conducted, that provide for the evaluation of non-test variables as predictors of college academic achievement. In a study at Brown University, Nicholson (1970), for example, found that a rating given by high school counselors could be used "as a variable as good or better than those traditionally used from the cognitive domain" (p. 11). Cognitive measures referred to in the Nicholson investigation included the average of College Board achievement tests and the verbal and mathematics subtest scores on the Scholastic Aptitude Test. In connection with a study conducted at Duke University, Wing and Wallach (1971) provided a rationale for excluding both test data and "grades" data

in college admissions. At the University of Northern Colorado, Hein and Leonard (1970) employed information from the high school record in a multiple regression system that included five ACT Program scores. They found that the test scores made no significant, unique contribution to the prediction of college performance.

The Military Experience

Training in the various military specialties approaches a level of complexity beyond that found in some post-secondary education. Since the service organizations must devote a considerable portion of their resources to training activities, and since training is a major element in maintaining some degree of efficiency, those background factors relating to pre-service education will probably increase in relative importance as military equipment and operations become more intricate.

With most of its new men and women having at least a high school diploma, the Air Force is probably in a better position than the other military services to capitalize on pre-service educational information in channeling incoming people into the necessary training programs. Since 1964, accordingly, aptitude indexes (which before 1964 had been based solely upon test performance) have included "bonus points" given for the completion of certain high school courses. It was earlier found that course-completion information on five high school courses could be used to predict technical training success almost as well as this success could be predicted with aptitude test scores (Judy, 1960). In a later study (Judy, 1970) pertaining to 13,811 airmen in 24 analysis groups, it was found that for 23 of the 24 groups there was no statistically significant difference (at the .05 level) in the validities reported for the aptitude information and the "education" information. In this last study, self-report data on level-of-performance (as "above average," "average," or "below average") on a longer list of high school courses were employed.

The maximum role of the secondary school record in predicting technical-training performance in military situations has not yet been fully explored, but the military studies do demonstrate that "years of education" and "high school graduation status" (graduate versus non-graduate) long used in large-scale military selection studies, are not the optimum measure on "educational background." The long-standing civilian practice of depending upon HSA or HSR to predict college academic performance is, in some ways, analogous to the older military practice of depending upon "years of education" or high school "graduation status" to indicate future training success. In both settings, "aptitudes" and other kinds of examination scores are still given the major consideration in the "operational" decisions.

A final reference is made to a study conducted at the United States Air Force Academy (Judy and Westen, 1971). Using the high school transcripts on a sample of 300 students in the Class of 1973, non-self-report data were assembled, in a binary configuration, to show which secondary courses each student in the sample had taken, and, for the courses taken, level of performance. A point-biserial correlation coefficient was computed between each item of information (represented by a "1" or an "0" on computer tapes), and the normalized score on academic rank at the Academy. Table 1 shows the distribution of the statistically significant items of information. History and certain other subjects did not seem to matter

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Insert Table 1 about here.

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in this special situation. A plus sign in a column indicates that the datum was positive and statistically significant (at the .05 level) in its relationship with Academy performance; a minus sign in a column indicates that the datum was negative and statistically significant. The four levels of performance, 1 through 4, was "high" to "low" for the listed courses; a minus sign in the last column indicates that not having the listed course was a disadvantage. The tabulation

shows the importance of good pre-Academy performance in English, mathematics, and science on the part of prospective students. The results are somewhat less definitive for the high school foreign language courses. In general, information on level-of-performance in the listed courses was found to be more important than course-completion information.

In a subsequent, unreported analysis, a second sample of 300 transcripts belonging to students in the Class of 1973 were scored using the "key" indicated in Table 1. A value of +1 was assigned when a transcript item agreed with a plus value on the key, and a value of -1 when a transcript item agreed with a minus value on the key. The transcript "score" consisted of the algebraic sum of all +1 and -1 values, plus a constant, the constant being equal to the number of minus items on the key. It was then observed that this "score" could be used to account for almost 40 per cent of the variation in academic performance at the Academy, whereas, in the same analysis group, HSR could be used to account for less than 30 per cent. Computations which explore the potential role of "aptitude" tests generally show that such tests can be used to account for about 25 per cent of the variation in academic performance at the Academy (Westen and Lenning, 1973).

Earlier in this report it was noted that differences in grading practices and standards from high school to high school is often given as a reason why it is not possible to rely upon high school grades to predict college performance. Studies conducted at the Service Academies are therefore potentially very useful in helping to clarify this particular matter on a national scale. In the "Academy" studies, maximum variation in transcript format (and grade reporting) is encountered since the high school records come from all parts of the United States. By law, a systematic attempt must be made to include proportionate numbers of students from designated population areas of the country. In the more typical college situation, students are much more likely to be drawn from a more limited area of the country, especially in places where an important number of

colleges and universities are supported by state funds.

Procedures

The procedures used in the present study followed quite closely the procedures adopted for the USAF Academy study mentioned above. The total operation is essentially a simple and straightforward one. It provides for the advance isolation of elements of information relevant to the prediction of a college-performance criterion, and then combines these elements in a manner not unlike that used in arriving at test scores. The resulting index takes into direct account unspecified academic skills demonstrated in earlier academic settings. (High school chemistry, in the Academy study, seemed to function especially well in separating some persons with good prospects for doing well at the Academy from other persons with poor prospects there. In a HSA, by contrast, chemistry receives no more computational attention than does the least demanding course listed on a transcript.) Perhaps even more importantly, however, the index takes into indirect account certain other unspecified indications concerning interests, interest patterns, motivations, or proclivities of the various kind which are contained on the high school record and which seem likely to be useful in identifying young men and women who will do well in the college situation. Clerical operations with respect to the handling of high school transcript information in the Academy study, and in the present study, have been described in greater detail in another place (Judy, 1971).

Subjects

The subjects were 1972 graduates of metropolitan-area high schools who entered San Antonio College in the Fall of 1972. A sample of 1000 students, only those who had taken courses in high school qualifying them for admission to at least one of the colleges at the University of Texas at Austin, and those who had also taken American College Testing Program (ACT) tests, was selected. Full-time freshman students entering San Antonio College are required to submit scores on

ACT, but admission is open (without regard to test scores) to all otherwise qualified persons. Scores on the Scholastic Aptitude Tests of the College Board are acceptable in lieu of ACT scores, but, as indicated, only students who had taken ACT were chosen for this study. The 1000 students were randomly divided into two groups, one a key-development group (N = 500) and one a holdout group (N = 500). The "holdout" group was the analysis group for this study.

The Data

The key for keying transcript information assembled for this study was generated from transcript data on four English courses (Eng I, Eng II, Eng III, Eng IV), six mathematics courses (Alg I, Geom, Alg II, Trig, Anal Geom, Elem Analysis), five social study courses (Amer Hist, Amer Gov, World Hist/Geog, Economics, Psychol/Sociol), and four science courses (Phy Sci, Biol, Chem, Physics). Listed below are the variables chosen for this study, identified by code letters:

HSTS - High School Transcript Score. The score for each student in the holdout (analysis) group obtained by applying the key-development "key."

HSR - High School Rank score. For members of the analysis group, high school rank was translated into units of measurement by first determining "percent position" (PP = 100(100 - .5)/N) where N is the number ranked in the high school class, and then, assuming normal distribution, referring to appropriate tables for the rank "score."

HSA - High School Average (as in the ACT Program). For members of the analysis group, average of the last high school grades in English, mathematics, social studies, and natural science, the four self-reported grades assembled on students in colleges participating in the American College Testing Program. This value has been described as being very near the average value obtained when grades in all high school courses are averaged (Lindquist, 1961).

TENG - Test English, ACT Program. For members of the analysis group, standard score on the English sub-test of the ACT Program Test.

TMATH - Test Mathematics, ACT Program. For members of the analysis group, standard score on the mathematics sub-test of the ACT Program Test.

TSS - Test Social Science, ACT Program. For members of the analysis group, standard score on the social science sub-test of the ACT Program Test.

TSCI - Test Science, ACT Program. For members of the analysis group, standard score on the science sub-test of the ACT Program Test.

ACTC - ACT Composite. For members of the analysis group, the composite score on the ACT Program Test, the average of the standard scores in English, Mathematics, Social Science, and Science.

CGPA - College Grade Point Average. For members of the analysis group, average of all grades obtained in the first semester at college.

The Analyses

Intercorrelations among all variables were computed and a series of regression problems were solved for the purpose of evaluating the utility of HSTS used alone and used in combination with other information of the kind normally employed in the prediction of grade-point-average in college (CGPA). With respect to the results obtained through the solution of the regression problems, the predictive role of selected variables was estimated on the basis of the magnitude of the difference between two squared multiple correlation coefficients (R^2), one obtained for a "full model" (see Ward, 1962) and the other obtained for problems in which selected variables have been eliminated (refer to Ward's "restricted model"). The variance ratio (F) was used to test the statistical significance (always at the .01 level) of the difference between the two R^2 values.

Results

Table 2 shows the means and standard deviations of the variables evaluated in this study, and, in the last eight columns, the intercorrelations among those

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Insert Table 2 about here.

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variables. Code letters, as described above, are used in identifying the table entries. Special attention is called to the first column of the intercorrelation matrix (column four, CGPA, in Table 2) which shows the relationships between College Grade Point Average (CGPA) and each of the variables examined as "predictors" of that measure. The CGPA-HSTS relationship ($\underline{r}$ = .59) was the strongest relationship observed. The CGPA-HSR relationship was observed to be .56, and the CGPA-HSA relationship, .51. (The best-weight combination of all the test variables in this study led to a multiple $\underline{R}$ value of .40.) The relative magnitude of these particular relationships is the matter of principal interest. In the remaining portion of this section of the report the predictors are evaluated, in context with one another, in their joint contributions to the prediction of academic performance.

Table 3 gives the sequence of regression problems solved and shows the results obtained. The sequence of problems was an arbitrary and intuitive one,

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Insert Table 3 about here.

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suggested and guided by the magnitude of entries reported in the intercorrelation matrix reported in Table 2. The problems are presented in six clusters with the first problem in each cluster being a "full model" problem, a problem utilizing two or more predictors. In the "restricted model" problems that immediately follow each of the "full model" problems, various predictors are removed to show the loss in $\underline{R}^2$ value attributable to the removal. The functioning of the removed variable(s) is thus determined. Asterisks identify the problems in which the loss is $\underline{R}^2$ value (i.e., "full model" $\underline{R}^2$ minus "restricted model" $\underline{R}^2$) is large enough to be statistically significant at the .01 level.

In the first cluster of three problems it should be noticed that even though HSR functioned better than HSA as a predictor of college averages in this study, HSA maintains some residual utility in the joint prediction of those averages. [The High School Rank score (HSR), rather than an unscaled average such

as HSA, is more likely to be the "high school record" data used in most selection situations. Also, since both "measures" pertain to the high school record, and since the rank score is derived from average grades in a particular high school class, the two indications are commonly looked upon as relating to essentially the same attribute.] It was found here that when HSR and HSA are used together in a prediction system, and when each, in turn, is removed from that system, the reduction (.0741 and .0152) in $\underline{R}^2$ (from .3335) is, in each instance, large enough to be statistically significant. The loss was much greater when HSR was removed, but it does appear that some predictive efficiency is lost when only rank information is considered, and that it is not necessary to go beyond two commonly-used, commonly-available summary indications on the high school record to show that high school "rank" information, as "record" information, does not provide for the highest possible prediction of college grades.

In the first problem in the second cluster of problems listed in Table 3 (Problem 4), HSR and the composite score of the American College Testing Program Test (ACTC) were used in a "full model" problem. When HSR was removed as one of the predictors (Problem 5), the $\underline{R}^2$ value decreased from .3309 to .1221, a loss of .2088. When ACTC was removed (Problem 6), the decrease was less (.0126), about the same as when HSA was removed in the first cluster (Problem 3). In the present instance, the results are seen to be similar to those in many selection situations in which a test score and high school rank data are used in linear combination to predict CGPA. The contribution of the test information is statistically significant, but the contribution occurs in the presence of a presumably-deficient indication pertaining to the "high school record."

In the third cluster (Problems 7, 8, and 9) the High School Transcript Score (HSTS) is used for the first time in the prediction. Here (in Problem 7) HSTS is used with HSR in the "full model" problem. When HSTS was removed from the system (Problem 8), the $\underline{R}^2$ loss was .0461. When HSR was removed (Problem 9),

the loss was .0142. Both losses, though small, were large enough to be statistically significant, but HSR emerges as the auxiliary predictor this time. HSTS is observed to be the best predictor of college-level academic performance. HSR apparently still has a supplemental role to play much as HSA does when HSR and HSA are used together as predictors.

In the fourth cluster of problems in Table 3, HSTS, found to be the best "high school record" predictor, was used in combination with ACTC in predicting academic performance in college (Problem 10). When HSTS was removed (Problem 11), the loss in the R^2 value of .3521, was .2300. When ACTC was removed (Problem 12), the loss was only .0019, a loss not large enough to be statistically significant. ACTC is seen, then, as a variable that makes no significant contribution to the prediction of college achievement in the presence of HSTS.

In the first of a fifth series of problems (Problem 13), ACTC, HSTS and HSR were all three used in a "full model" problem. The full model R^2 of .3665 declined by .0356 when HSTS was removed (Problem 14), and by .0144 when HSR was removed (Problem 15). Both of these reductions were statistically significant (F = 27.87 and F = 11.27 respectively), but the removal of HSTS caused the greatest loss to the full model R^2. When ACTC was removed (Problem 16), the R^2 value declined by .0021, an amount not large enough to be statistically significant (F = 1.64).

In a final series of problems (Problem 17 through Problem 20), the four subtests of the ACT Program Test were substituted for the ACT Program Composite score (ACTC). This was done to allow, in the regression problems, maximum opportunity for the selection test data to show residual utility in the prediction of CGPA. When the four tests were removed from the regression system (Problem 20), the R^2 value for the full model equation declined by .0120, an amount not large enough to be statistically significant.

Discussion

In interpreting the results of studies in which comparisons are made between two or more correlation values, a very important consideration always has to do with the likelihood that range restrictions on one or more of the correlated measures are operating to prevent the comparisons from being definitive ones. This is true because such restrictions necessarily reduce the magnitude of the observed relationships, these reductions most often occurring in situations in which selection procedures are used to eliminate some or many of the candidates. If criterion information (school- or job-performance information) is available on only a part of the applicant group, then the relationships between "predictors" of the criterion information, and the criterion information itself, will pertain to only a part of the applicant group, not to all of it. It is common practice, then, to "correct" correlation coefficients for restriction in range on the selection variables. In college admission studies this is frequently done with respect to test scores employed in selection, but rarely so with respect to other data used in the selection process. Erroneous conclusions are therefore commonly reached concerning the relative predictive utility of test data and educational record data.

In the present study it was not necessary to make "corrections" in the CGPA-test relationships because test results are not used in making admissions decisions at San Antonio College. There was no restriction in range brought about by selection on test variables. The restriction in range on the <u>educational</u> variables (i.e., the elimination from consideration of the records of students who had not taken all the high school courses necessary for university admission) was a planned part of the research design. In the sampling operation the goal was to come up with a group of young people who would resemble, as closely as possible, persons thought likely to be candidates for UTSA admission in the Fall of 1976. Establishing of minimum educational background requirements served to identify, better, a potential UTSA applicant group.

A reduction in range on test scores, however occasioned, and whether at the lower end of the "aptitude" scale or at the higher end, operates to reduce the magnitude of the relationship that can be reported between those scores and the criterion at hand. The reference here to the "higher end" of the scale is not only to the somewhat better test performance of the students at some of the private colleges in the San Antonio area, but also to the better performance of an unknown number of students who now leave the metropolitan area each year to attend colleges and universities elsewhere. With the opening of UTSA to undergraduate enrollment, some of the higher scoring high school students will probably choose to apply for UTSA admission. Many others in the higher "aptitude" category, especially those who can afford the extra expense, will probably continue to migrate. There is some evidence that students at the new urban campuses being established by state universities in the United States represent a different strata of American society than do the students at the central campuses, and especially the students at the more selective private institutions.

The heterogeneity of a group on one variable affects the magnitude of the observed relationship between that variable and any other variable. Another factor which is of some importance is the reliability or stability of the correlated measures. The accuracy of prediction that is possible to achieve is limited by the reliability of the variable used as a predictor. In particular, in interpreting the results of this study, and in considering their implications, it appears necessary to take into some account the possibility of obtaining improved data on the educational record. In the San Antonio area, it was noted in the course of the study, there is a rather serious deficiency with respect to the lack of standard practices and procedures in keeping educational records, and this extends to the supposedly simple matter of arriving at grade averages upon which "high school rank" is based.

At some San Antonio high schools, when grade-point-averages are computed,

all grades on the transcript are averaged, including those earned in varsity athletics (almost all such grades are "A"), Band, R.O.T.C., and Driver Education. At other high schools, some of these are included. It was surprising to find schools in the same District, presumably following written policy set down by a central administrative office, differing from one other in the course grades included in the averages. This last variation, however, was much less than variation in procedure from District to District. It was also observed that there is a definite need for audit and review procedures to identify, and to insure the correction of, computational errors. In the data assembled for this study, the observed errors were certainly not rare.

Another practice, also somewhat different from District to District and from school to school, but with different implications for different students in the same District, or the same school, was one that assigns a different number of grade points for students making the same grade in different presentations of the same course. At one high school, for example, where a seven-point scale is used in computing a grade-point-average for each student, the grading was as follows:

Enriched Course	Regular Course	Basic Course	Grade Points
A			7
B	A		6
C	B		5
D	C	A	4
	D	B	3
		C	2
		D	1

A majority of San Antonio schools employ variations of this plan. It was observed, too, that most of the students in "enriched," "major works," or "honors" courses receive "A" or "B" for their performances whereas many of the students in "basic" or "developmental" courses tend to receive "C" or "D." Only in the "regular" courses are near normal distributions of grades sometimes found. The important thing to notice, overall, is that <u>different</u> scales in <u>different</u> schools are used for <u>different</u> students in essentially <u>different</u> courses.

In this study, as already indicated however, high school "rank" data and "grades" data, in their present condition and format, were used in the prediction of college performance. No effort was made to recompute "rank" in the various high schools on the basis of a common set of course grades (not possible without the entire number of records of a given high school graduating class), or even to correct the errors made in computing grade averages on which the reported "rank" was based. No allowances of any kind were made for the circumstance that grades pertaining to the "same" course are often taught at different levels, and evaluated differently for different students. As points of departure for determining "high school rank," or for the derivation of "high school transcript score," it is apparent that the available data were somewhat less precise than they might otherwise be, and that, in this particular respect, they are characteristic of earlier data of the kind normally utilized in college admission studies.

If test information has no incremental validity in the presence of indexes derived from "high school record" data of the quality available for this study, results should be somewhat more conclusive with better information from those records. High school "rank" data, because they can be used to force a similar distribution of rank "scores" for the different high schools, should generally predict college grades better than high school "averages." The findings of this study support the practice of using "rank" information, rather than average grades, if only one of these are to be employed in making college admissions decisions. Rank scores are probably more "fair" in certain areas where high schools differ considerably in the social, economic, and/or racial composition of their student bodies.

Summary and Conclusions

This report began with an observation that college admissions is now a critical problem in many countries. In the United States the administrative trend has been toward the expansion of facilities for higher education so that

larger numbers of young people might be able to attend some college or university. In the American situation, the principal contest is increasingly becoming an annual contest for admission to one of the "better" institutions. The intensifying competition is not surprising in view of the expanding awareness of the economic and social advantages that accrue to young people who attend the more selective schools. When some applicants are admitted and some are rejected, however, the question often asked is: How are these decisions made? Or: How should these decisions be made?

A widely accepted point of view is that the fairest basis for college admissions is one on merit that favors applicants in accordance with the best possible estimate of their relative prospects for doing well in a particular academic setting. It has generally been shown, in hundreds of studies on the topic, that the "high school record" is the best single predictor of college-level achievement, and that the best predictions are made when "high school record" information is given more weight than selection-test scores when admissions decisions are made. In actual admissions practice, however, test scores are often given the most effective weight. In the first part of this report, four main points are made in connection with the past studies on college admissions.

1. The "average" grade shown in grade-point-averages, which determine "rank" in high school class, may not adequately summarize the heterogeneous content of the high school record. An "average" grade masks important differences with respect to the courses students take. The lack of standard approaches to the computation of averages, and the common scarcity of effective review procedures for correcting ordinary computational errors, also contribute to the unreliability of "high school grades."

2. The recommended ratios for weighting test scores and "high school grades" are empirically derived. Whatever the deficiencies in grades or grading, the recommended ratios reflect the existing utility of the data in best-weight

prediction equations. It is often erroneously inferred that, relative to "high school grades," test scores are more dependable and valid for selection purposes because of known differences in grading practices and standards. There <u>are</u> differences in these practices and standards, but the differences, though sometimes large, are not generally large enough to justify the negative inferences commonly made.

3. Even the best weights given to the best current predictors do not permit forecasts of college achievement that are particularly accurate. Actually, not more than about a third of the variation in college performance can generally be predicted through the use of test scores and "high school record" information. This leaves much room for improvement in the prediction of college-level achievement.

4. Historically, for the purposes of academic prediction, more attention has been given to the measurement of "intelligence," "mental ability," and "scholastic aptitude" than to the quantification of any equivalent amount of data obtainable from the existing academic record, data extending over a longer sample of an individual's functioning than two or three hours of test behavior. Almost no effort has been devoted to the identification and quantification of significant items of information on school records, or to the identification of items which should be given effective weight in arriving at a summary record "score."

In giving the objectives of the present study, it was pointed out that the opening of a major urban university in San Antonio, Texas, is highlighting a perennial college admissions issue that has not been satisfactorily resolved anywhere, and that the total situation in higher education in this location is somewhat analogous to the current situation in higher education in the State of Texas as a whole, and, to some extent, in the nation as a whole. In the study carried out, the focus of attention was upon standards and policies that govern admission to post-secondary education. In particular, these questions were asked: 1) With

respect to standards which serve to predict college performance, do the accepted generalizations hold when it comes to the relative utility of test scores and information from the high school record? 2) Does the use of a high school "grade-point-average" (HSA) or rank based on that average (HSR) lead to erroneous conclusions concerning the maximum predictive utility of measures derived from the previous academic record?

A high school transcript score (HSTS), a hypothetically better "measure" pertaining to the high school record, was generated and evaluated in context with other information of the kind normally employed in making recommendations and decisions on college admissions. It was found that neither a high school grade-point-average (HSA) nor a high school rank (HSR) provided for the optimum prediction of college grades. More specifically, it was found that:

1. High School rank information, in the precision shown on high school transcripts examined in this study, does not provide for the optimum prediction of college grades. High school rank is clearly a better predictor than high school average (this does not agree with an American College Testing Program statement concerning the relative usefulness of an approximate "average" and high school rank) but the American College Testing Program "average" does maintain some predictive utility in the presence of high school rank. This is taken as one indication that there is predictive information on high school transcripts not now being systematically employed.

2. High school rank information, in the precision shown on transcripts examined in this study, maintains predictive utility in the presence of the American College Testing Program Composite Score, but the test information also maintains predictive utility when test scores and high school rank, in the precision generally reported, are used in linear combination to predict college grades.

3. High school rank information, in the precision shown on transcripts examined in this study, maintains predictive utility in the presence of the ex-

perimental "high school transcript score." High school rank, although not a better predictor than the "high school transcript score," should be retained as a component part of the high school record information when attempts are made to predict college grades.

4. In the presence of a high school transcript score, as developed and evaluated in this study, the American College Testing Program Composite Score makes no statistically significant contribution to the prediction of college grades.

5. When high school rank information, the high school transcript score, and the American College Testing Program Composite Score are jointly used to predict college grades, the removal of the high school transcript score from the prediction causes the greatest loss, the removal of high school rank causes a lesser, though still a statistically significant, loss. The removal of the American College Testing Program Composite Score did not cause a statistically significant loss.

6. The four sub-tests of the American College Testing Program tests, in linear combination with high school rank information and the high school transcript score, do not contribute, statistically, to the prediction of college grades.

It is therefore observed, then, that in making college admissions decisions and recommendations, it is generally best to use a carefully obtained high school rank in conjunction with an empirically developed high school transcript score in the prediction of college achievement. In the presence of these two indexes, used jointly, selection test scores become redundant.

Recommendations

The recommendations offered below, although these must necessarily pertain particularly to the situation in higher education in the San Antonio, Texas, metropolitan area, are ones that have direct implications for educational practices and policies elsewhere. The problems here are problems common to higher education. Many issues remain unresolved.

1. Since high school rank is widely employed in college admissions decisions, and since that information also maintains predictive utility in the presence of a more comprehensive high school transcript score as developed and evaluated in this study, it is recommended that more care and precision be as widely exercised in obtaining and recording "high school rank" information. The most obvious need, in field settings such as the one in which the present study was conducted, is a common policy covering the identity of the high school courses that are to be used when high school grade-point-averages are computed, and those that are not to be used. In Texas, the courses probably should be selected, not arbitrarily but exclusively, from the "list of approved courses" in Bulletin 560 of the Texas Education Agency. It is almost unbelievable that regents, or trustees, of public colleges and universities in a designated area are able, rather independently and unrelatedly, to establish admissions standards for entering students, that these prominently include indications on "high school rank," and that there is no orderly, specified plan, and a formal auditing procedure, which might effectively control the way grade-point-averages are obtained. High school rank is based upon these important averages. It seems imperative that early steps be taken to regularize this non-trivial matter.

2. The first recommendation does not depend entirely upon the results of the present study to make it an appropriate one. The second recommendation, likewise, is not altogether an outgrowth of the results reported here. There does seem to be a need, however, for some kind of a moratorium on the proliferation of courses taught at two or three levels in high school, and of special courses open, in fact or in effect, only to those with "talent" or extra money. It would appear that the twin pressures of Sputnik and a lingering non-acceptance of court-mandated desegregation may have had some added influence on the actual practice in many places, but it is really not otherwise clear why Course 1 of Subject A (Algebra I, for example) should be taught at a "developmental" level,

a "regular" level, and at an "honors" level, assuming that Course 1 covers a finite number of concepts from the topic of Subject A and it is a pre-requisite for college admission. Entirely apart from the rationale for assigning students to the different classes for Course 1 of Subject A is the matter of teachers being able to come up with grades in Course 1 that will satisfactorily and accurately relate the performance of students who have received instruction in the different classes. (There are, perhaps, ways that one student, rather than another, can be allowed to progress to a higher level in the Subject A curriculum, but this should not operate to accentuate or conceal relative performances of students in the first course in Subject A.) Another critical situation, specifically, is that a large number of San Antonio students, more than a few of whom would appear to have good prospects for doing well in post-secondary education, regularly graduate from high school without having taken the required courses for a normal entrance into one of the "better" colleges. Related Mathematics I and Related Mathematics II, for example, meet the requirements for high school graduation in Texas, but not the academic requirements for college entrance in "better" institutions anywhere.

3. The third recommendation is one that follows quite directly from the findings of this study. It is that tape files be established at the University of Texas at San Antonio that will contain the full secondary-school record of each applicant for admission, and that these specifically include the secondary-school records of third-year undergraduate students who plan to enter UTSA in the Fall of 1975. Then, since a record of the previous undergraduate work will also be at hand, a key can be easily and conveniently developed that will relate high school performance to the earlier college achievement, wherever demonstrated. This key can then be used in the derivation of a trial "high school transcript score" for the applicants for the 1976 freshman class.

The adoption of this last recommendation will permit not only a replication of some parts of the present study, but also make possible other desirable

computations (using the basic data from high school records). Not much can be done to recompute the high school "rank" of a given student (unless all the records of a given secondary-school are on hand) but the selection of courses to be included in a high school "average" can be made without reference to the varying practices from high school to high school in computing averages. Even on the matter of courses taught at more than one "level," additional variables can be generated to reflect the varying circumstances, and to aid in isolating the additional predictive role, if any, of the available information on existing secondary-school records.

Finally, and perhaps most importantly, the adoption of the last recommendation of this report will permit not only the development of "high school record scores" which will provide for the optimum prediction of overall academic achievement at UTSA but also increasingly-accurate "scores" which will provide for the optimum prediction of achievement in the separate courses-of-study at UTSA, all without any necessary reference (sometimes unfair and harmful) to "aptitude" or "ability," or "intelligence." If admissions decisions can be made on an educational-program or a course-of-study basis, and there are parallel developments in the other colleges and universities in the San Antonio metropolitan area, it should no longer be necessary to view these institutions as being in an "hierarchy" with respect to one another, or with respect to institutions of higher education elsewhere.

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Table 1

Statistically Significant Items of Information from the High School Record which Predict Academic Order-of-Merit at the Air Force Academy[a]

High School Course	Level of Performance in Course 1	2	3	4	Course Not Taken
English II (Second Course)	+		-	-	
English III (Third Course)	+		-	-	
English IV (Fourth Course)	+		-	-	
Math II (Plane Geometry)	+		-	-	
Math III (Adv. Alg., Trig)	+		-	-	
Math IV (Elem. Analysis)	+	+	-	-	-
Math V (The Calculus)	+			-	-
Biology I (First Course)	+		-	-	
Chemistry I (First Course)	+		-	-	
Physics I (First Course)	+		-	-	-
A Romance Language II	+	+	-	-	
A Romance Language III			-	-	
A Romance Language IV				-	
A Non-Latin Language II	+			-	
A Non-Latin Language III	+				
A Non-Latin Language IV					

[a]Adapted from Judy and Westen (1971). A "plus" indication shows that the item of information was positive and statistically significant at the .05 level. A "minus" indication shows that the item of information was negative and statistically significant at that level.

Table 2

Variables (Listed by Code[a]) Showing Means, Standard Deviations, and Intercorrelations

(Based on records of 500 San Antonio College students)

CODE	MEAN	SD	CGPA	HSTS	HSR	HSA	TENG	TMATH	TSS	TSCI
CGPA	2.54	.74								
HSTS	35.50	8.25	.59							
HSR	57.12	15.19	.56	.85						
HSA	2.67	.63	.51	.70	.76					
TENG	16.99	5.24	.35	.45	.40	.41				
TMATH	13.73	6.22	.33	.53	.46	.46	.51			
TSS	17.13	6.95	.27	.39	.31	.36	.61	.52		
TSCI	19.12	6.20	.22	.40	.31	.37	.55	.56	.71	
ACTC	18.14	5.11	.35	.53	.44	.48	.79	.78	.37	.86

[a]See text for identification of variables.

Table 3

Sequence and Results of Regression Problems

(N = 500)

Problem No.	Predictors in Problem[a]	R^2	R^2 loss	F
1.	HSR, HSA (Full Model)	.3335		
2.	HSA (HSR removed)	.2594	.0741	55.26**
3.	HSR (HSA removed)	.3183	.0152	11.33**
4.	HSR, ACTC (Full Model)	.3309		
5.	ACTC (HSR removed)	.1221	.2088	155.09**
6.	HSR (ACTC removed)	.3183	.0126	9.36**
7.	HSR, HSTS (Full Model)	.3644		
8.	HSR (HSTS removed)	.3183	.0461	36.05**
9.	HSTS (HSR removed)	.3502	.0142	11.10**
10.	HSTS, ACTC (Full Model)	.3521		
11.	ACTC (HSTS removed)	.1221	.2300	176.43**
12.	HSTS (ACTC removed)	.3502	.0019	1.46
13.	HSTS, HSR, ACTC (Full Model)	.3665		
14.	HSR, ACTC (HSTS removed)	.3309	.0356	27.87**
15.	HSTS, ACTC (HSR removed)	.3521	.0144	11.27**
16.	HSTS, HSR (ACTC removed)	.3644	.0021	1.64
17.	HSTS, HSR, TENG, TMATH, TSS, TSCI	.3764		
18.	HSR, 4 Tests (HSTS removed)	.3396	.0368	29.09**
19.	HSTS, 4 Tests (HSR removed)	.3644	.0120	9.49**
20.	HSTS, HSR (4 Tests removed)	.3644	.0120	2.37

[a]See text for identification of variables.

**F statistically significant at .01 level. With r and $(N - p)$ degrees of freedom, where p is the rank of the full matrix of predictor scores, and r is the difference between p and the rank of the matrix of the predictor scores after the variables hypothesized to have parameter weights of 0 have been removed (Ward, 1962).